

FORM PTO-1390 U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE (REV. 9-2001)		ATTORNEY'S DOCKET NUMBER 367.40917X00 filed December 10, 2001
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		
INTERNATIONAL APPLICATION NO. PCT/GB00/02249	INTERNATIONAL FILING DATE June 9, 2000	PRIORITY DATE CLAIMED June 10, 1999
TITLE OF INVENTION A DISPLAY MODULE		
APPLICANT(S) FOR DO/EO/US JOHNSON, TERENCE PHILIP LEWIS, IAN DAVID		
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:		
<p>1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.</p> <p>2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.</p> <p>3. <input type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.</p> <p>4. <input checked="" type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (Article 31).</p> <p>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)) a. <input type="checkbox"/> is transmitted hereto (required only if not communicated by the International Bureau). b. <input checked="" type="checkbox"/> has been communicated by the International Bureau. c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office(RO/US)</p> <p>6. <input checked="" type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)). a. <input checked="" type="checkbox"/> is attached hereto. b. <input type="checkbox"/> has been previously submitted under 35 U.S.C. 154(d)(4).</p> <p>7. <input type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)) a. <input type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau). b. <input type="checkbox"/> have been communicated by the International Bureau. c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. d. <input type="checkbox"/> have not been made and will not be made.</p> <p>8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</p> <p>9. <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</p> <p>10. <input type="checkbox"/> An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</p>		
<p>Items 11 to 20 below concern document(s) or information included:</p> <p>11. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</p> <p>12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</p> <p>13. <input checked="" type="checkbox"/> A FIRST preliminary amendment.</p> <p>14. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.</p> <p>15. <input type="checkbox"/> A substitute specification.</p> <p>16. <input checked="" type="checkbox"/> A change of power of attorney and/or address letter.</p> <p>17. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.</p> <p>18. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4).</p> <p>19. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).</p> <p>20. <input checked="" type="checkbox"/> Other items or information: Figs. 1-2,3a-3b,4a-4b,5a-5b,6a-6b,7,8a-8b; Credit Card Payment Form; PCT Request Form; International Publication No. WO 00/77563; International Preliminary Examination Report</p>		

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER		
10/009333	PCT/GB00/02249	367.40917X00		
21. The following fees are submitted:		CALCULATIONS PTO USE ONLY		
BASIC NATIONAL FEE (37 CFR 1.492(a) (1) - (5)): <input type="checkbox"/> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO.....\$1040.00 <input checked="" type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO.....\$890.00 <input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO.....\$740.00 <input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4).....\$710.00 <input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4).....\$100.00				
ENTER APPROPRIATE BASIC FEE AMOUNT =		\$890.00		
Surcharge of \$130.00 for furnishing the oath or declaration later than months from the earliest claimed priority date (37 CFR 1.492(e)).		<input type="checkbox"/> 20 <input type="checkbox"/> 30 \$		
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	\$
Total Claims	- 20 =		x \$18.00	\$
Independent Claims	- 3 =		x \$84.00	\$
MULTIPLE DEPENDENT CLAIMS(S) (if applicable)		+ \$280.00 \$		
TOTAL OF ABOVE CALCULATIONS =		\$890.00		
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.		+ \$		
SUBTOTAL =		\$890.00		
Processing fee of \$130.00 for furnishing the oath or declaration later than months from the earliest claimed priority date (37 CFR 1.492(f)).		<input type="checkbox"/> 20 <input type="checkbox"/> 30 \$		
TOTAL NATIONAL FEE =		\$890.00		
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property		+ \$		
TOTAL FEES ENCLOSED =		\$890.00		
		Amount to be refunded:		\$
		charged:		\$
a. <input type="checkbox"/> A check in the amount of \$ _____ to cover the fees is enclosed. b. <input type="checkbox"/> Please charge my Deposit Account No. <u>01-2135</u> in the amount of \$ _____ to cover the above fees. A duplicate copy of this sheet is enclosed. c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. <u>01-2135</u> . A duplicate copy of this sheet is enclosed. d. <input checked="" type="checkbox"/> Fees are to be charged to a credit card. WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.				
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.				
SEND ALL CORRESPONDENCE TO:				
Antonelli, Terry, Stout & Kraus, LLP 1300 North Seventeenth Street Suite 1800 Arlington, VA 22209 USA				
 SIGNATURE Carl I. Brundidge NAME 29,621 REGISTRATION NO.				

10/009333

367.40917X00
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: P. JOHNSON, et al

Serial No.: Not yet assigned

Filed: December 10, 2001

For: DISPLAY MODULE

Group: Not assigned

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

December 10, 2001

Sir:

Prior to examination, please amend the above-identified application as follows.

IN THE CLAIMS

Please cancel claims 15, 17 and 18 without prejudice or disclaimer of the subject matter thereof.

Please amend the claims as follows:

5. (Amended) A display module as claimed in claim 3, wherein the flexible driver support is a flexible printed circuit (FPC) foil.

6. (Amended) A display module as claimed in claim 1, wherein the intermediate element is flexible.

8. (Amended) A display module as claimed in claim 1, wherein the intermediate

element comprises LCD device power control circuitry.

9. (Amended) A display module as claimed in claim 1, wherein the first and second display drivers are on opposed sides of the LCD.

10. (Amended) A display module as claimed in claim 1, wherein the display drivers are positioned along the first axis.

11. (Amended) A display module as claimed in claim 1, wherein the intermediate element interconnects the first and second display drivers.

12. (Amended) A portable device comprising a display module as claimed in claim 1.

13. (Amended) A radio communications device comprising a display module as claimed in claim 1.

14. (Amended) A radiotelephone comprising a display module as claimed in claim 1.

IN THE ABSTRACT

Please replace the Abstract with the attached Abstract.

REMARKS

Attached hereto is a marked-up version of the changes made to the claims by the current Amendment. The attached page is captioned "**Version with markings to show changes made**".

Please charge any shortage in fees due in connection with the filing of this paper, or credit any overpayment of fees, to the deposit account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (367.40917X00).

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP



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ABSTRACT

A display module is disclosed which may be employed in a portable device or the like. The module comprises a liquid crystal display device comprising a liquid crystal display, and a display driver element for driving the LCD. It also comprises a connector for connecting LCD device circuitry to the portable device, and an intermediate element for interfacing the LCD device and the connector.

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

Please cancel claims 15, 17 and 18 without prejudice or disclaimer of the subject matter thereof.

Please amend the claims as follows:

5. (Amended) A display module as claimed in claim 3 or 4, wherein the flexible driver support is a flexible printed circuit (FPC) foil.

6. (Amended) A display module as claimed in ~~any preceding claim 1~~, wherein the intermediate element is flexible.

8. (Amended) A display module as claimed in any preceding claim 1, wherein the intermediate element comprises LCD device power control circuitry.

9. (Amended) A display module as claimed in ~~any previous claim 1~~, wherein the first and second display drivers are on opposed sides of the LCD.

10. (Amended) A display module as claimed in ~~any previous claim 1~~, wherein the display drivers are positioned along the first axis.

11. (Amended) A display module as claimed in ~~any previous claim_1~~, wherein the intermediate element interconnects the first and second display drivers.

12. (Amended) A portable device comprising a display module as claimed in ~~any~~ preceding claim 1.

13. (Amended) A radio communications device comprising a display module as claimed in ~~any of claims~~ claim 1 to 11.

14. (Amended) A radiotelephone comprising a display module as claimed in ~~any of claims~~ claim 1 to 11.

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A Display Module

The present invention relates to a display module. In particular, the invention relates to the configuration of a display module for a portable device.

Current display devices comprise a liquid crystal display (LCD) and a driver. Typically, the driver is mounted on a printed circuit board (PCB) of the portable device and connections are routed between the LCD and PCB. Figures 8(a) and (b) of the accompanying drawings illustrate display devices having single and x-y driver LCD displays respectively.

According to the present invention, there is provided a display module for a portable device, comprising a liquid crystal display device comprising a liquid crystal display (LCD), and a display driver element for driving the LCD, a connector for connecting LCD device circuitry to the portable device, and an intermediate element for interfacing the LCD device and the connector.

This configuration of display device, with an integrated driver, results in a reduction in the number of connections required for connection to the portable device, thus improving reliability and reducing the display space required. Moreover, it facilitates assembly and serviceability of the portable device as well as module reusability.

The intermediate element is preferably located substantially behind the LCD device, so as to further reduce the area of the display module. The area of the display may be yet further reduced by the provision of a display driver element comprising a flexible driver support. Such a support may be folded back from the LCD to contact an intermediate element positioned behind the LCD, for example.

Likewise, the intermediate element may be flexible, thereby enabling bending to contact the driver element (or support) and to bring the connector into contact with the portable device.

The flexible driver support and/or flexible intermediate element may be an flexible printed circuit (FPC) foil, thereby being lightweight and durable.

The intermediate element preferably comprises LCD power control circuitry. This leads to a further reduction in the number of connections required to be made to the portable device, and display space required in the portable device.

In an embodiment of the present invention, the LCD device of the display module comprises first and second driver elements comprising respective first and second drivers for driving the LCD. These first and second driver elements may be positioned on opposed sides of the LCD, in which case the intermediate element preferably interconnects the first and second driver elements. Further, the LCD may comprise first and second liquid crystal cells driven by the respective first and second driver elements.

This configuration of display device reduces the routing required between the drivers and cells compared with that shown in Figure 8(a), having a single liquid crystal cell of the same size. Consequently, the resolution is improved for that size of display. Likewise, the size of display is increased for a given resolution. This configuration also has a better contrast ratio over the single driver solution due to the lower multiplexer (MUX) rate. Moreover, the active area to glass ratio is improved since the number of conductive tracks which need to be routed to each driver is substantially reduced, compared to a single driver arrangement. Subsequently, having a reduced number of conductive tracks further reduces the amount space around the edge of the glass plates used for routing the conductive tracks.

The present invention therefore enables a larger active area to be achieved on a LCD display device. Further, if the display drivers are positioned on opposing ends of LCD display device, the LCD advantageously has a symmetrical active area.

When the first and second display drivers are positioned at opposed sides of the LCD along the first axis of the display device, the device has a minimum width/height. For example, when the first axis extends in the direction of the height of the LCD (vertical configuration), the display device has a minimum width for a given size of LCD, whereas when the second axis extends in the direction of the width of the LCD (horizontal configuration), the display device has a minimum height for a given size of LCD.

The latter configuration is particularly useful for employment in radiotelephones and the like. Firstly, the minimum height enables the softkeys (function keys associated with items presented on the display) to be close to the display. Secondly, it facilitates the design of a phone that uses a slide to obtain the correct spacing between the microphone and earpiece.

Optionally, the LCD may be substantially symmetrical about a bisector. In this event, the liquid crystal cells are substantially aligned in one direction at least and preferably in both directions so that the device appears to be a unitary large display. Moreover, preferably the LCD and drivers are substantially symmetrical. This results in the usable area of the device being substantially symmetrical and no additional width/depth being required for the display to appear symmetrical in a device such as a radiotelephone. Accordingly, a device having such a configuration has a light weight to active area ratio.

According to another aspect, there is provided a portable device comprising a display module of the present invention.

According to a further aspect, there is provided a radio communications device comprising a display module of the present invention.

According to yet another aspect, there is provided a radio telephone comprising a display module of the present invention.

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings of which:

Figure 1 is a block diagram of a display device according to an embodiment of the present invention;

Figure 2 is an exploded view of a display module according to an embodiment of the present invention;

Figure 3a is a perspective view from the front and rear of the display module of Figure 2;

Figure 3b shows various views of the display module of Figure 2;

Figure 4a is a perspective view from the front and rear of the LCD device interconnect;

Figure 4b shows various views of the LCD device interconnect;

Figure 5a illustrates the LCD device according to an embodiment of the present invention;

Figure 5b illustrates a tab of the LCD device of Figure 5a in more detail;

Figures 6a and 6b respectively illustrate horizontal and vertical configurations of the LCD device of different embodiments of the present invention;

Figure 7 illustrates a portable device comprising a display device of the present invention; and

Figures 8a and 8b illustrate conventional display devices, Figure 8a illustrating a device with a single display driver and Figure 8b illustrating a device with an x-y driver.

Figure 1 is a block diagram of a display device according to an embodiment of the present invention. The display device 10 comprises an LCD panel 11, two display drivers 14, 15 and an FPC unit 16. The LCD panel 11 is a "split" display. That is, it consists of two LCDs 12,13 made up of individual cells sandwiched between common glass plates. The glass plates have a conductive coating, as is typical in LCD devices. The LCD 12 is driven by one of the display drivers, namely master display driver 14 and the LCD 13 is driven by the other display driver, slave driver 15. The master and slave drivers 14, 15 are synchronised and the two cells are abutted so that the two LCDs 12, 13 look like a single large display. The FPC unit 16 couples the master and slave display drivers and interfaces with external circuitry to obtain the necessary control and data signals and the like. The FPC unit may comprise the power supply control circuitry as will be explained further below with reference to Figures 2, 4a and 4b.

In this embodiment, serial interface signals (such as serial clock period (SCL), serial interface (SI), data/command indicator (AO), master and slave chip select (master XCS, slave XCS) and reset timing signals) are received by the FPC unit 16 as the serial interface for the display device 10. These signals are forwarded to the display drivers 14, 15. The FPC device also receives the

display device power supply (VDD, VSS). The drivers, in turn, output liquid crystal drive signals to drive the respective LCDs 12, 13.

In this example, the display drivers 14, 15 are Seiko Epson 1565 series dot matrix LCD drivers. These drivers have two main kinds of liquid crystal drive pins, SEG pins which are liquid crystal segment drive outputs and COM pins which are common drive outputs. Synchronisation of these devices when used in a master/slave configuration is handled internally by the driver devices.

As can be seen, in this embodiment the master and slave drivers are positioned on each side of the LCD panel 11. In this horizontal configuration, the routing of common drive outputs in the x-direction is reduced when compared, for example, with a single driver device such as that shown in Figure 8a. Consequently, a high resolution can be attained for large displays. In this case, the LCD panel 11 may have a pixel matrix of 111 x 106, pixel size of 0.19 x 0.22 mm and pixel pitch of 0.22 x 0.24 mm. Also, a reduced display height is also possible when compared, for example, with an x-y driver device of equivalent LCD panel size and resolution, such as that shown in Figure 8b. Furthermore, the device is substantially symmetrical, thus avoiding the need to compensate for any asymmetry when used in a device such as a portable device, as is the case with x-y driver devices. This, in turn, results in weight and volume savings.

As will be appreciated, Figure 1 is merely a block diagram, and the circuitry can be implemented in a number of ways. Two alternative configurations are illustrated in Figure 6.

Figure 2 is an exploded view of a display module 20 according to an embodiment of the present invention. The display module 20 comprises a liquid crystal display screen or panel 21, a lightguide 22, a reflector 23, a plastics support frame 24, two LCD tabs 25 and an FPC foil 26. Optionally,

the module may also comprise a diffuser between the panel 21 and the lightguide 22. More detailed views of these components can be seen in Figures 3 to 5. The panel 21 is a split screen as in the Figure 1 embodiment, and likewise has two display drivers. These drivers are located on a respective tab 25, and are referenced 251 in Figure 2. The tabs 25 also each comprise a connector 252 comprising the driver pins etc. which connect to the LCD panel 21, and a connector 253 comprising pins for connecting to the serial interface and for coupling the two drivers 251. The driver connector 252 comprises of the order of 182 pins, and the FPC foil connector 23 comprises of the order of 28 pins. The FPC foil comprises power control circuitry 261 and a board to board connector 262. This board to board connector 262 is a 10 contact connector, of which 9 contacts are used as the serial interface to the display. This connector may plug into a corresponding connector on a PCB of the device in which the display module is to be used.

The number of contacts required to the PCB of the device is minimal due in part to the fact that the drivers are positioned on the tabs 25 of the module 20, (as opposed to the conventional position of on a PCB of the device), and in part due to the fact that the power control circuitry 261 is positioned on the FPC foil 26 of the module. (For example, this module uses only 9 external contacts, compared with in excess of 150 for a conventional single driver device). On an assembly line, the reduction in the number of contacts required provides significant advantages, since smaller connectors are quicker to assemble, cheaper, smaller, lighter and more reliable than connectors having a large number of contacts.

These components are assembled to form a module as shown in Figure 3a. The tabs 25 are fixedly attached to the display panel 21 to form an LCD tab assembly, as is illustrated in Figure 5a. This attachment may, for instance, be by bonding. The support frame 24 is designed with a recess 241 on its front face for receiving the reflector 23, lightguide 22, diffuser (if desired), and

display panel 21. It also comprises a number of notches 242 that correspond to respective tabs 221, 231 on the lightguide 22 and reflector 23 for location purposes.

Once the reflector 23 and lightguide 22 are located within the recess of the support frame, the LCD tab assembly is coupled to the support frame 24. In this embodiment, the support frame 24 comprises a flexible lug 243 on each corner for providing a push fit connection of the LCD panel to the support frame 24.

Subsequently, the FPC foil 26 is positioned on the rear of the support frame 24. The rear face of the support frame 24 is recessed to a depth slightly greater than the joint thickness of the tabs 25 and FPC foil 26. It also has orifices 246 for receiving the drivers 251 and orifices 247 for receiving the power control circuitry etc. Four protrusions 245 on the rear of the support frame serve to locate the main body of the FPC foil 26 by extending into corresponding holes 264 on the foil. The protrusions and holes are arranged so that the connectors 263 of the FPC foil 26 lie over the apertures 246 of the support frame. This assists in the connection of these connectors 263 with those 253 of the tabs 25, as is explained below. A neck 265 of the FPC foil is passed from the rear to the front of the support frame 24 so as to position the connector 262 in front of a connector support 248 portion of the support frame 24. The neck 265 is passed through a cable strap of the connector support 248, which keeps the neck 265 near the side of the connector support. The support 248 also comprises connector support flexible lugs 249 for providing a push fit connection of the connector 262 to the connector support 248. The connector 262 can then be pushed into the connector support to make a push fit connection.

The next assembly step is to connect the connectors 253 of the tabs 25 to corresponding connectors 263 of the FPC foil 26. The tabs 25 have folds 254

corresponding to the side edges of the frame, so that they may be wrapped tightly around the support frame 24. They also comprise holes 263 that correspond to the protrusions 245 on the rear of the support frame so as to locate the tab connectors 253 over those 263 of the FPC foil 26. As mentioned above, the connectors are located over the apertures 246 to assist in connection of the connectors. In this embodiment, prior to locating the tabs, a silicon rubber insulator is positioned in the apertures 246 behind the FPC foil connectors 263. The tabs are then located and the FPC foil and tab connectors 253, 263 are heat bonded together (by heating and applying pressure). The insulator is then removed from the module 20. Alternatively, of course, the insulator could be inserted prior to location of the FPC foil or after location of both the FPC foil 26 and the tabs 25.

Figure 3b shows different views of the display module of Figure 2, namely, front, rear, top, bottom and left side views. It also illustrates a pixel array. As mentioned above, in this embodiment, the dimensions shown may have a pixel size (a x d) of 0.19 x 0.22 mm and pixel pitch (b x e) of 0.22 x 0.24 mm. Consequently, in this case there is a horizontal pixel gap c of 0.3 mm and a vertical pixel gap f of 0.2 mm. The LCD cells can be abutted such that only a 0.3mm gap is apparent where they abut which is not noticeable by the human eye.

Figures 4a and 4b illustrate the FPC foil 26 in more detail. The connectors 263, components and tracking 261 may be applied to the foil using any of the known techniques.

Figure 5a shows front, left side and two bottom views of the LCD tab assembly comprising the tabs 25 and the display panel 21. One bottom view shows the assembly flat, and the other with the tabs folded along the folds 254. Figure 5b shows the tabs 25 in more detail. Preferably, the tabs 25 are

made of FPC foil and again the connectors, drivers and tracking are applied to the foil using any of the known techniques.

Figure 6 illustrates two different configurations of a display device with a "split screen", Figure 6a showing a display module 61 with a horizontal configuration, and Figure 6b showing a display module 69 with a vertical configuration. Each display module comprises an LCD panel 62 consisting of two LCDs 65, 66, and two display drivers 67, 68. The LCD 65 is driven by display driver 61, and the LCD 66 is driven by display driver 68. The drivers 67, 68 are synchronised and the cells of LCDs 65, 66 are abutted so that the two LCDs look like a single large display. As in the figure 2 embodiment, the drivers are on tabs 63, 64 and fold under the module to reduce the modules area. The tabs and or a separate element comprise the driver coupling and module interface. Both configurations enable the provision of a small compact module with minimum area and weight to display content. The area of the module is compact and the glass area to active area ratio is excellent. The horizontal configuration provides a minimum product height, whereas the vertical configuration provides a minimum product width.

A radiotelephone 70 comprising a display device 71 of the invention is illustrated in Figure 7. This radiotelephone has all the usual components of a radiotelephone, including an earpiece 74 and microphone 75. In this embodiment, the phone has a slide to extend the gap between the earpiece 74 and microphone 75 to that between a user's ear and mouth when the phone is to be used for conversation. This radiotelephone further comprises function keys 72. These keys are softkeys, that is, their function alters depending upon the item presented on the display 71. Preferably, the display device 71 in this radiotelephone 70 has the horizontal configuration of Figure 6b as its minimum height enables the softkeys (function keys associated with items presented on the display) to be positioned close to the display. Secondly, it facilitates the design of an well proportioned slide phone.

The present invention may be embodied in other specific forms without departing from its essential attributes. Accordingly reference should be made to the appended claims and other general statement's herein rather than to the foregoing specific description as indicating the scope of invention.

Furthermore, each feature disclosed in this specification (which term includes the claims) and/or shown in the drawings may be incorporated in the invention independently of other disclosed and/or illustrated features. In this regard, the invention includes any novel features or combination of features disclosed herein either explicitly or any generalisation thereof irrespective of whether or not it relates to the claimed invention or mitigates any or all of the problems addressed.

The appended abstract as filed herewith is included in the specification by reference.

Claims

1. A display module for a portable device, comprising:
a liquid crystal display (LCD) device comprising first and second liquid crystal cells positioned along a first axis of the display;
first and second display drivers for respectively driving the first and second liquid crystal cells; a connector for connecting LCD device circuitry to the portable device; and
an intermediate element for interfacing the display drivers and the connector.
2. A display module as claimed in claim 1, wherein the intermediate element is positioned substantially behind the LCD device.
3. A display module as claimed in any preceding claim, wherein the display drivers comprise a flexible driver support.
4. A display module as claimed in claim 3, wherein the flexible driver support flexes to contact the LCD and the intermediate element.
5. A display module as claimed in claim 3 or 4, wherein the flexible driver support is a flexible printed circuit (FPC) foil.
6. A display module as claimed in any preceding claim, wherein the intermediate element is flexible.
7. A display module as claimed in claim 6, wherein the intermediate element is an FPC foil.
8. A display module as claimed in any preceding claim, wherein the intermediate element comprises LCD device power control circuitry.

9. A display module as claimed in any previous claim, wherein the first and second display drivers are on opposed sides of the LCD.
10. A display module as claimed in any previous claim, wherein the display drivers are positioned along the first axis.
11. A display module as claimed in any previous claim, wherein the intermediate element interconnects the first and second display drivers.
12. A portable device comprising a display module as claimed in any preceding claim.
13. A radio communications device comprising a display module as claimed in any of claims 1 to 11.
14. A radiotelephone comprising a display module as claimed in any of claims 1 to 11.
15. A display module substantially as hereinbefore described with reference to and/or as illustrated in any one, or any combination of, Figures 1 to 6 of the accompanying drawings.
17. A portable device comprising a display module substantially as hereinbefore described with reference to and/or as illustrated in any one, or any combination of, Figures 1 to 6 of the accompanying drawings.
18. A radio communications device comprising a display module substantially as hereinbefore described with reference to and/or as illustrated

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in any one, or any combination of, Figures 1 to 6 of the accompanying drawings, with or without reference to Figure 7.

Abstract

A Display Module

A display module (20) is disclosed which may be employed in a portable device or the like. The module (20) comprises a liquid crystal display device comprising a liquid crystal display (21), and a display driver element (25) for driving the LCD. It also comprises a connector (262) for connecting LCD device circuitry to the portable device, and an intermediate element (26) for interfacing the LCD device and the connector.

[Figure 2]

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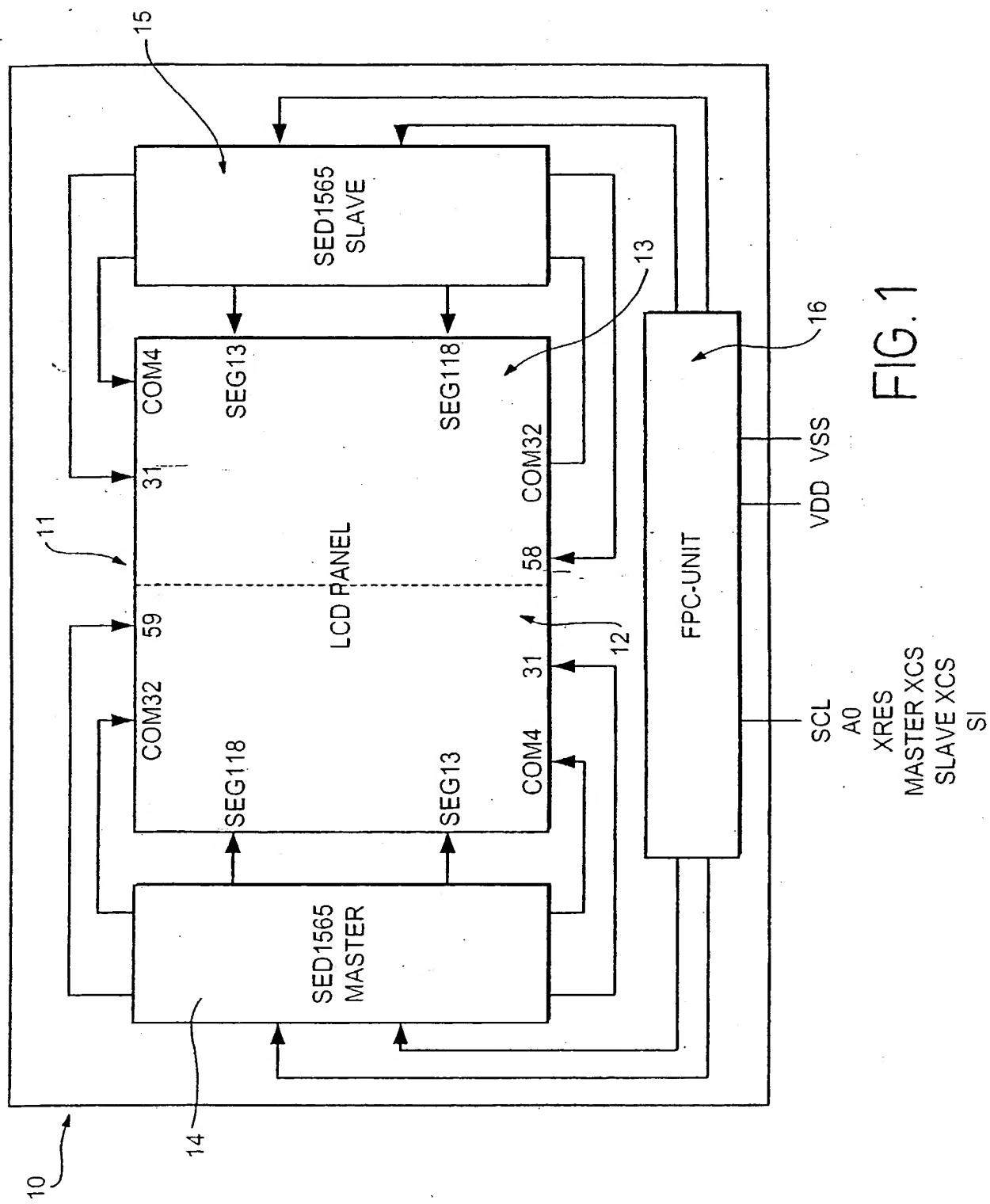


FIG. 1

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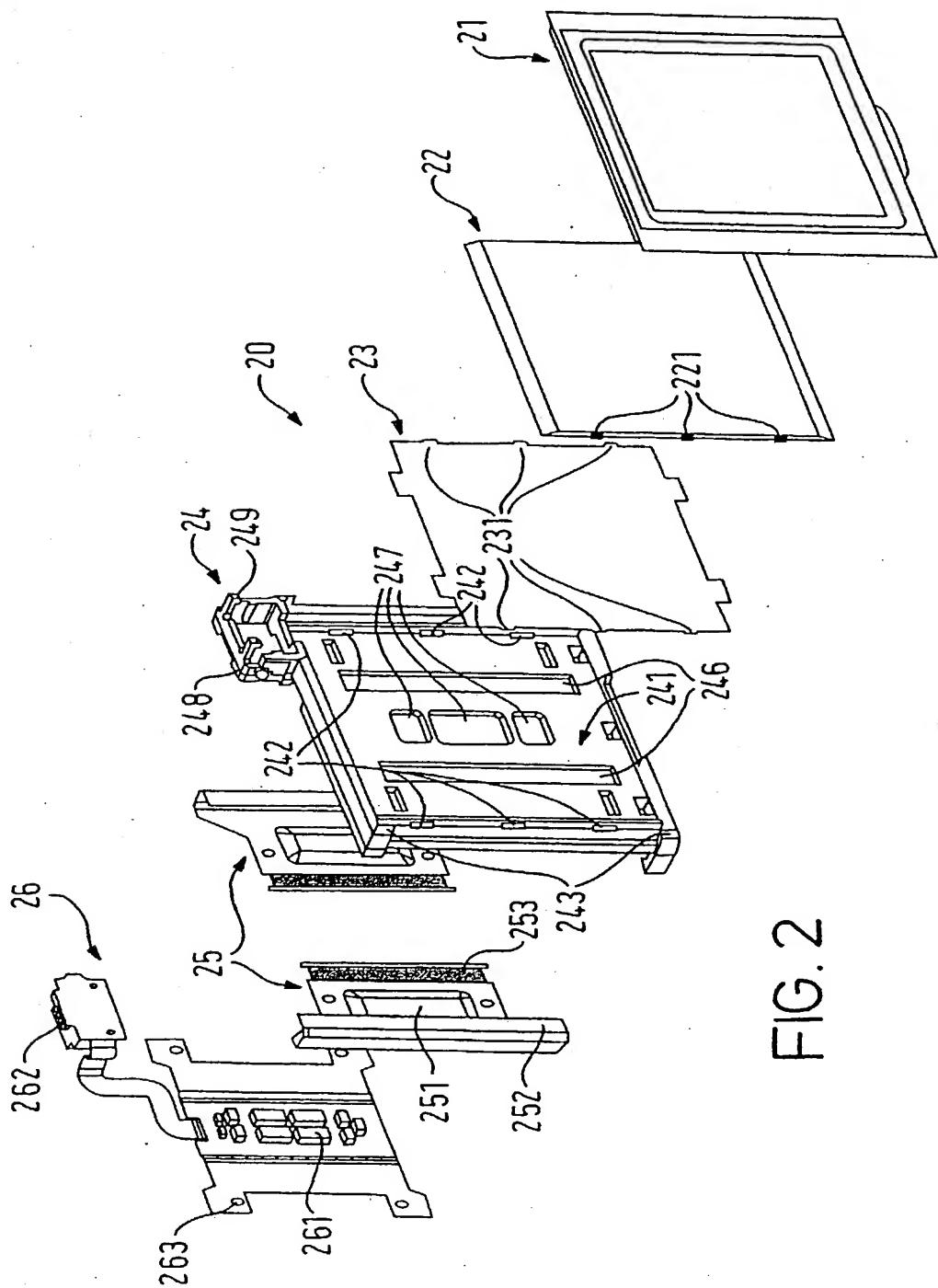
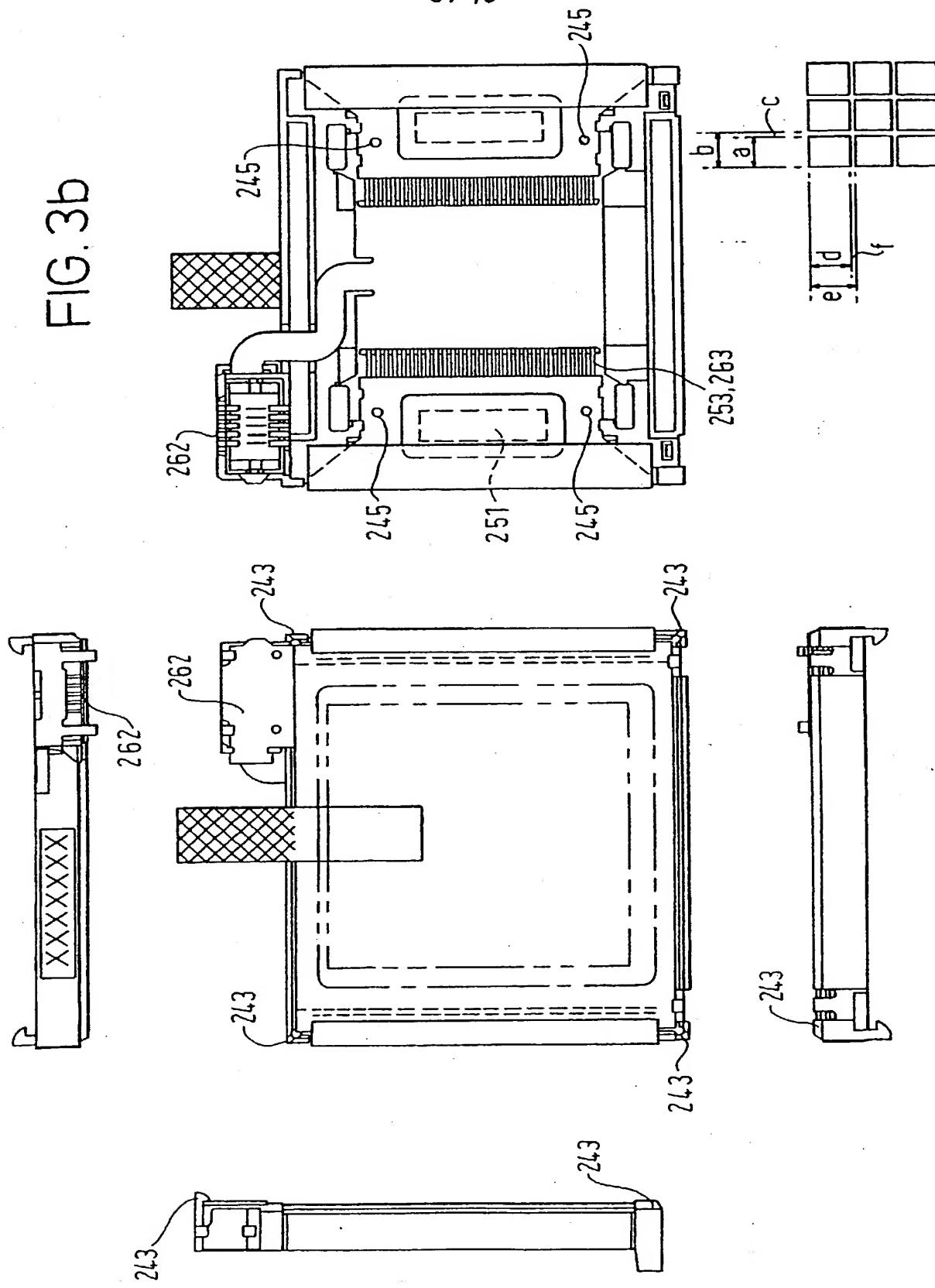


FIG. 2

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FIG. 3b



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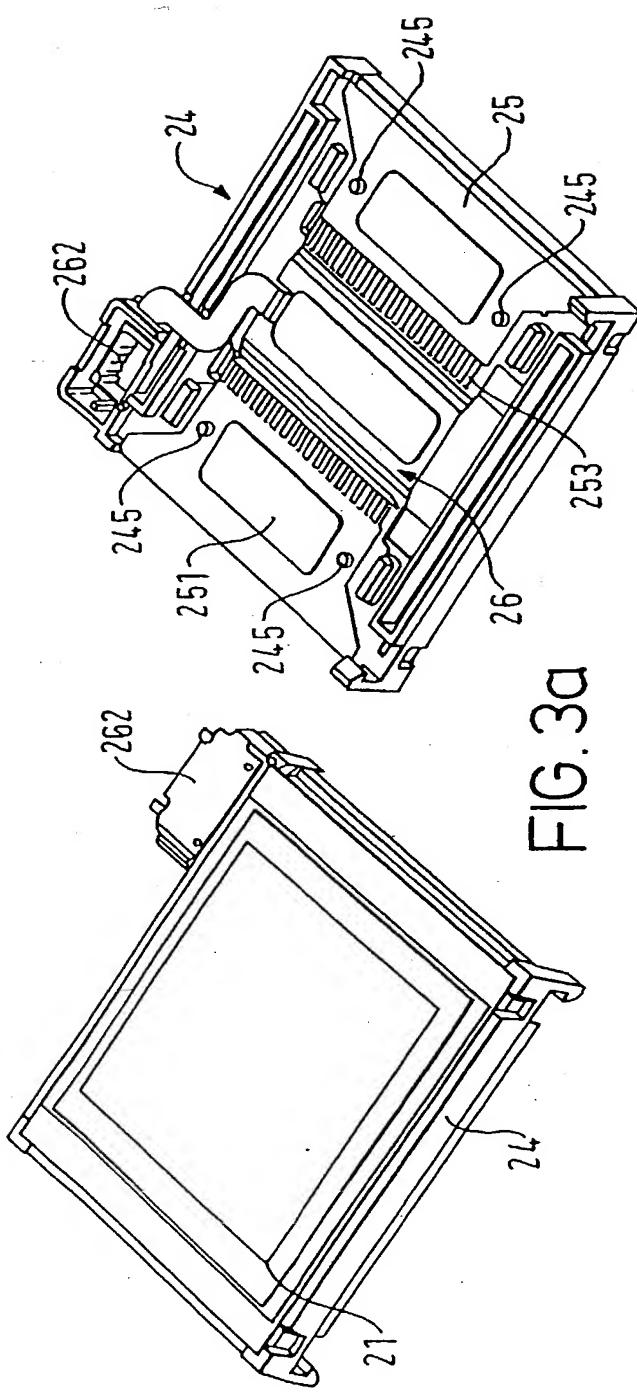


FIG. 3a

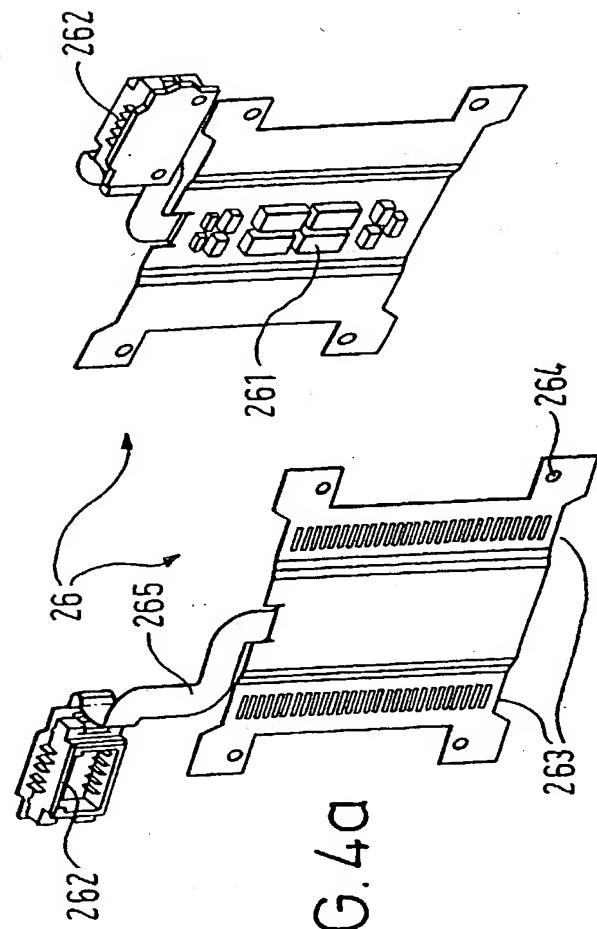


FIG. 4a

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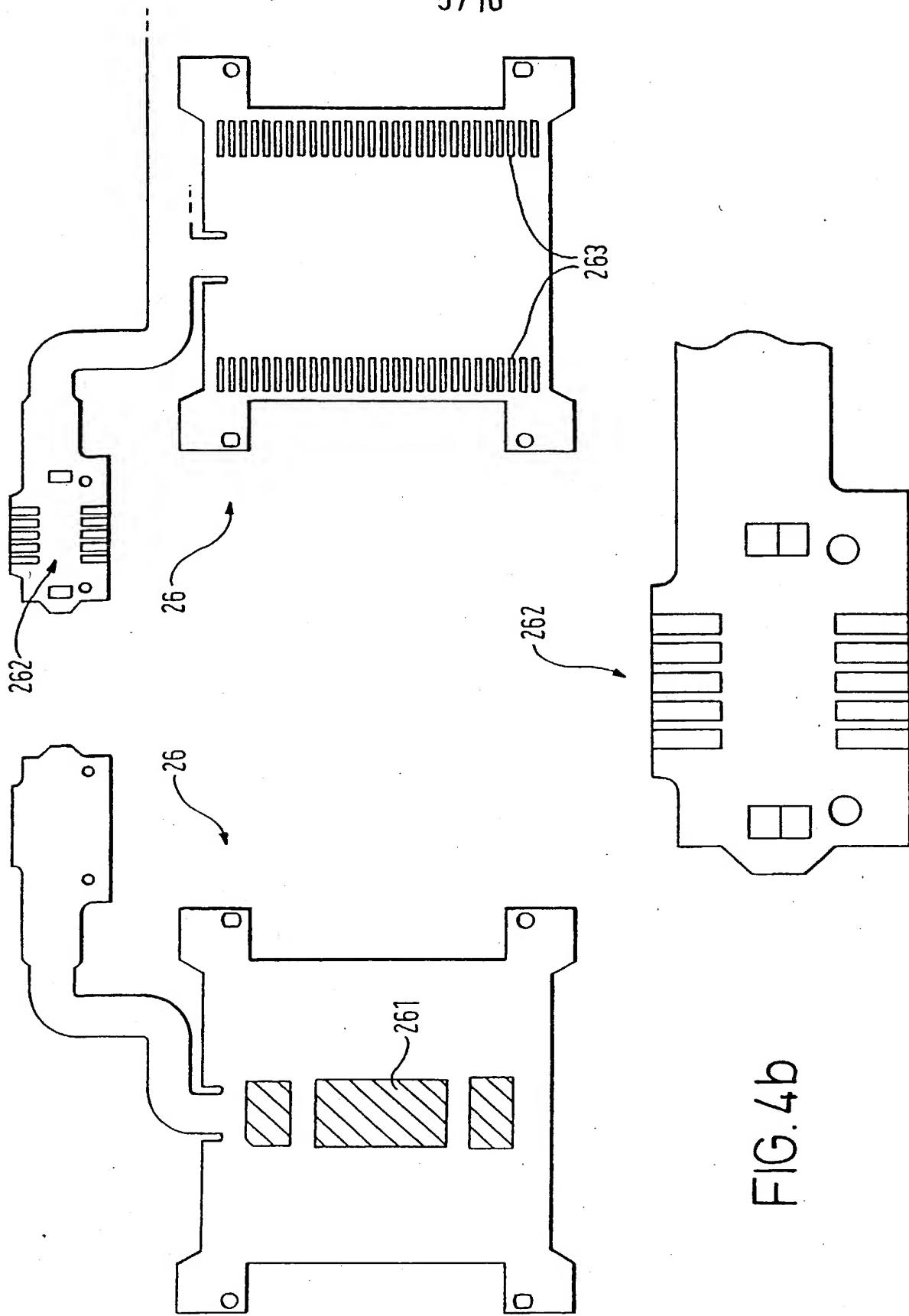


FIG. 4b

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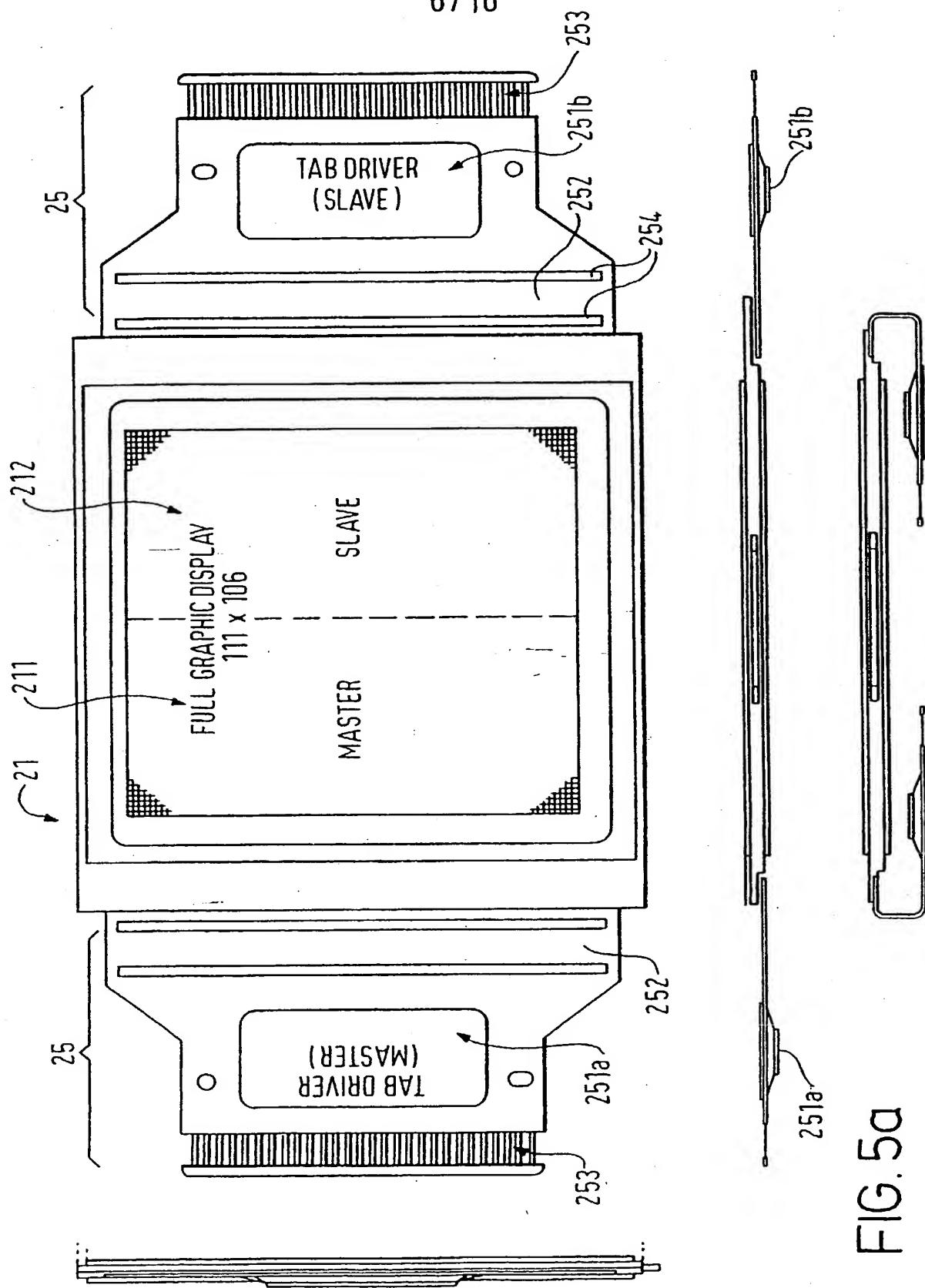


FIG. 5a

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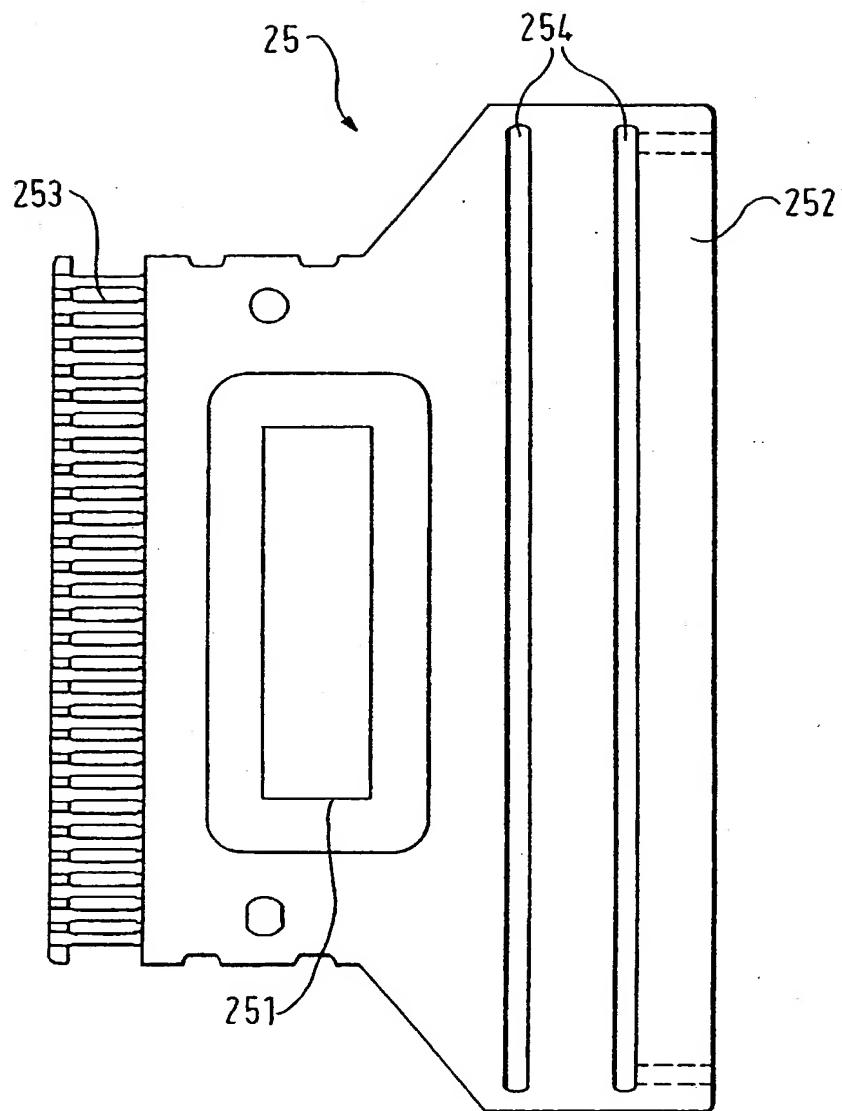


FIG. 5b

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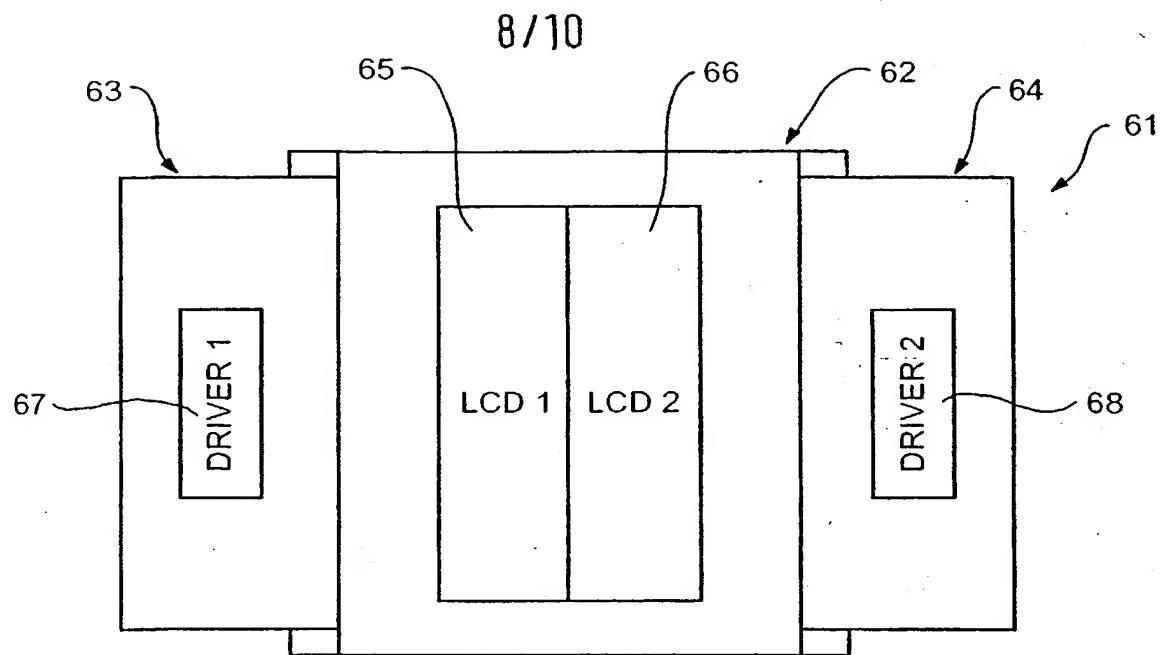


FIG. 6a

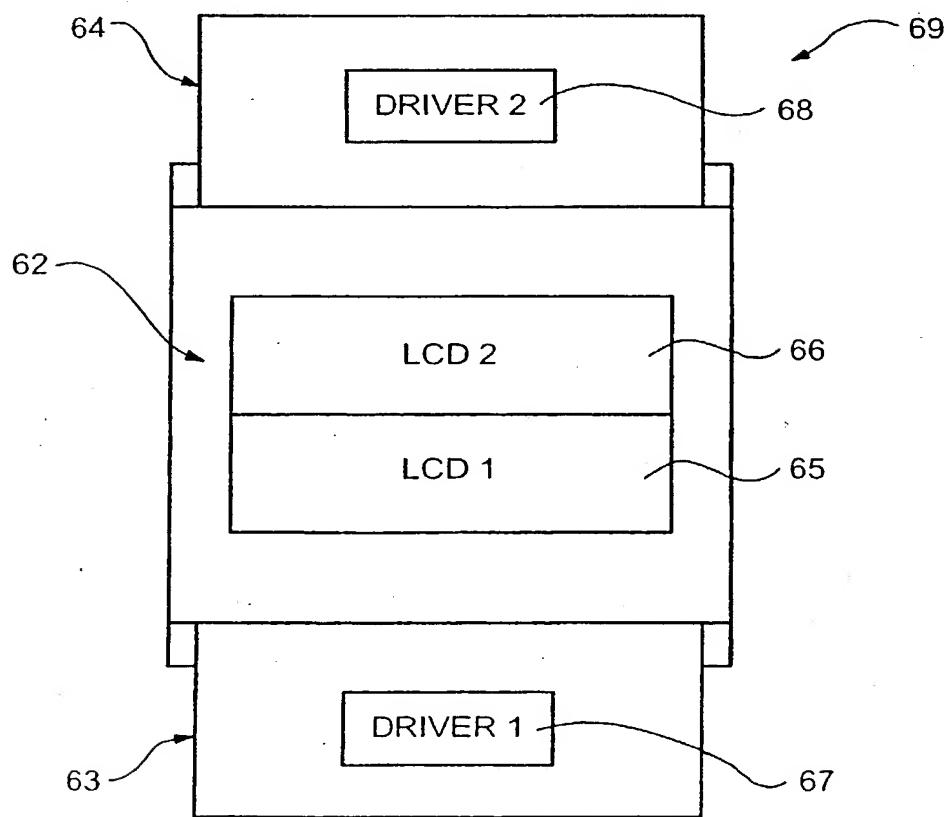


FIG. 6b

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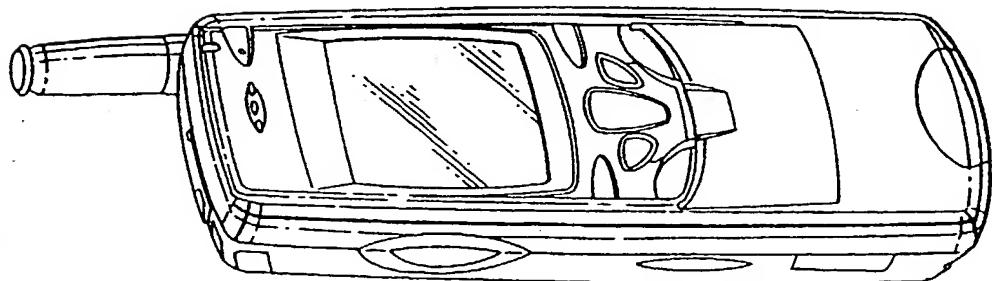
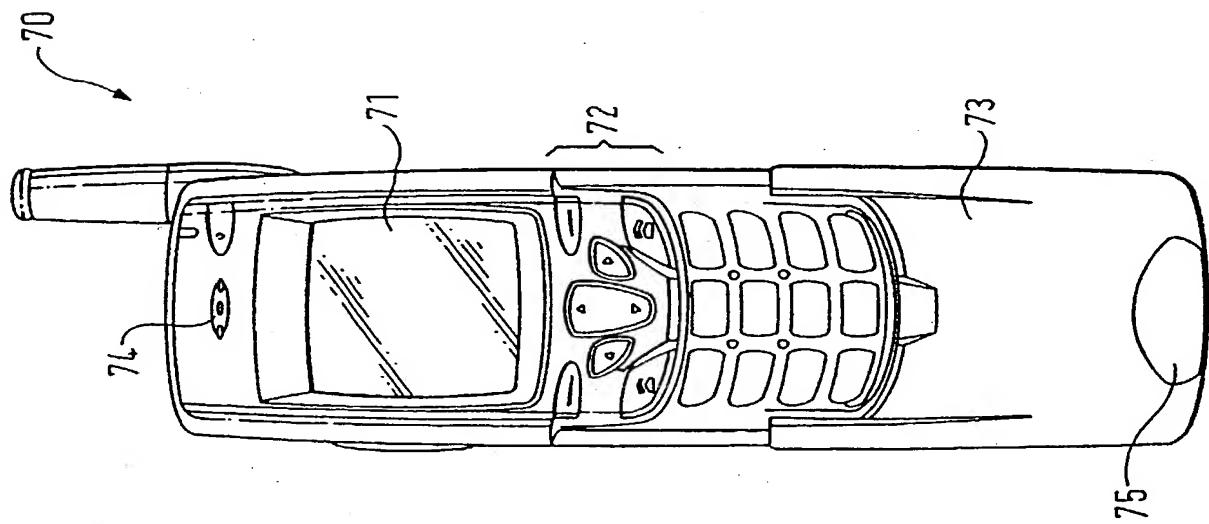
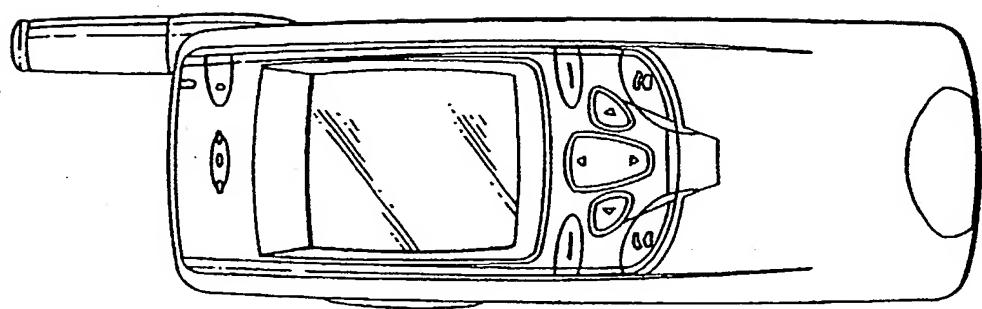


FIG. 7

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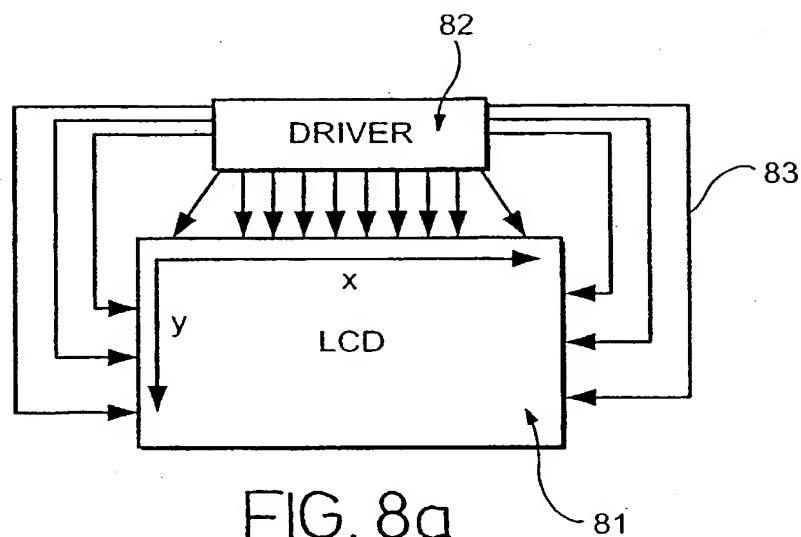


FIG. 8a

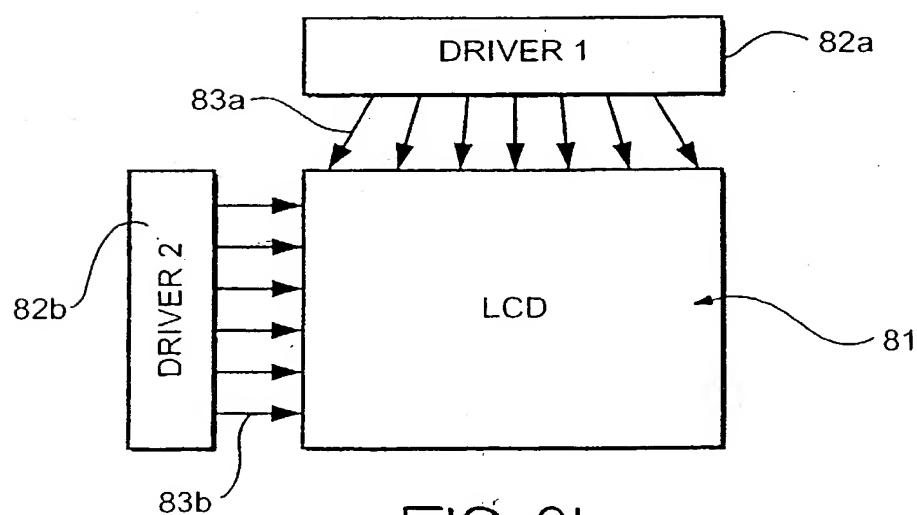


FIG. 8b

Attorney's Docket No. 367.40917X00 :

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that: my residence, post office address and country of citizenship are as stated below, next to my name; I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

A DISPLAY MODULE

the specification of which

is attached hereto.

was filed on 10 December 2001 as
United States Application Number 10/009333
or PCT International Application Number PCT/GB00/02249
and was amended on _____
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above. I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits, under 35 U.S.C. 119(a)-(d) or 365(b), of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or any PCT international application having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

Priority Claimed?

<u>9913539.4</u> (Number)	<u>GB</u> (Country)	<u>10 June 1999</u> (Foreign Filing Date)	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
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_____ (Application Number)	_____ Filing Date
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_____ (Application Number)	_____ Filing Date	_____ (Status -- patented, pending, abandoned)
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I hereby appoint: Donald R. Antonelli, Reg. No. 20,296; Melvin Kraus, Reg. No. 22,466; William I. Solomon, Reg. No. 28,565; Gregory E. Montone, Reg. No. 28,141; Ronald J. Shore, Reg. No. 28,577; Donald E. Stout, Reg. No. 26,422; Alan E. Schiavelli, Reg. No. 32,087; James N. Dresser, Reg. No. 22,973; Carl I. Brundidge, Reg. No. 29,621; Paul J. Skwierawski, Reg. No. 32,173; and Robert M. Bauer, Reg. No. 34,487; of ANTONELLI, TERRY, STOUT & KRAUS, LLP with offices located at 1300 North Seventeenth Street, Suite 1800, Arlington, Virginia 22209, my attorneys, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith. 11

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TEL: (703) 312-6600
FAX: (703) 312-6666

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

1-00
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Inventor's Signature J. D. Lewis Date 1/08/02
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